MP3

The compression format that changed the music world

Francisco Pinto

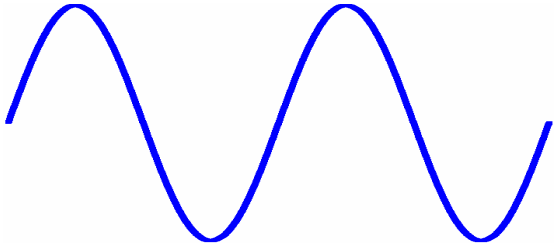
1. History of MP3

Timeline

- **1924**, J. Egan, H. Hake and R. Ehmer discover the masking principle.
- **1983**, Prof. O. Bonello, from University of Buenos Aires, initializes the research on perceptual audio coding.
- **1988**, J. Johnston, from Lucent Technologies, receives the first patent on perceptual audio coding.
- **1989**, Fraunhofer-Gesellschaft Institute receives a German patent for MP3.
- **1992**, MP3 is standardized by the Moving Picture Experts Group (MPEG).
- **1995**, Fraunhofer researchers unanimously vote for .mp3 as the file-name extension for MPEG Layer 3.
- **1996**, The popular MP3 decoder Winamp is released on the internet.
- **1998**, Diamond Multimedia releases the first portable MP3 player.

2. Evolution of Audio Storage

Vinyl Record

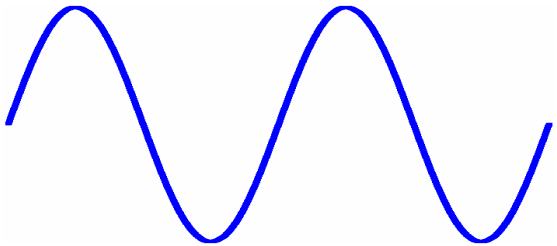


Analog signal

Vinyl recording

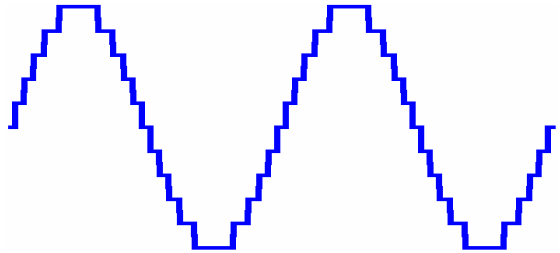
2. Evolution of Audio Storage

Compact Disc



Analog signal

Sampling and Quantization



Pulse-code modulated signal

Reed–Solomon error correction

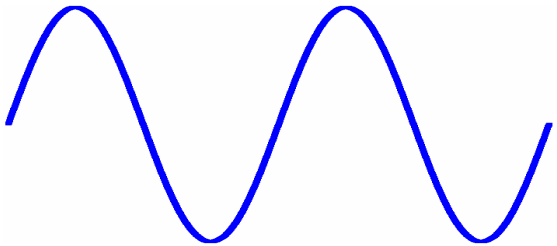
0100110111001001

Scrambled Bit stream

CD burning

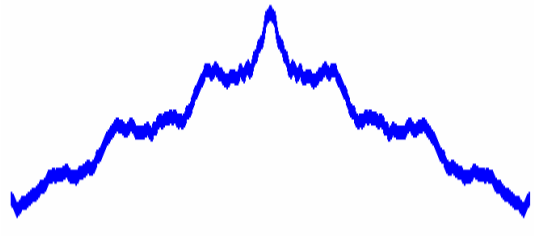
2. Evolution of Audio Storage

Spectral Coding



Analog signal

Sampling and FFT



Signal spectrum

Bit allocation

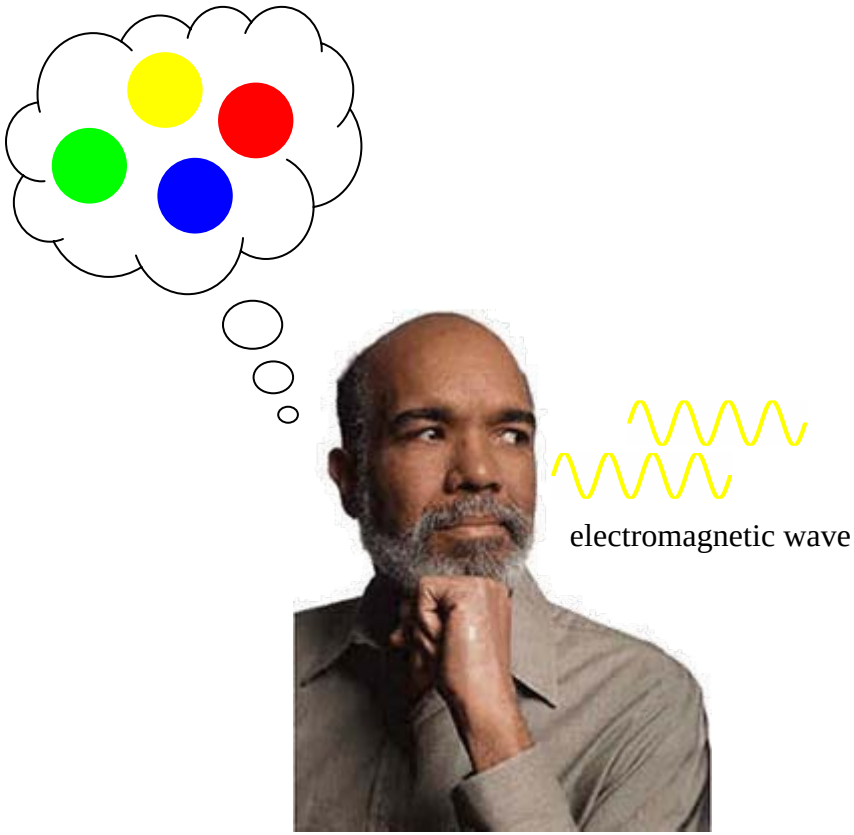
0100110111001001

Bit stream

HD Storage

3. Sound Perception

What is sound?

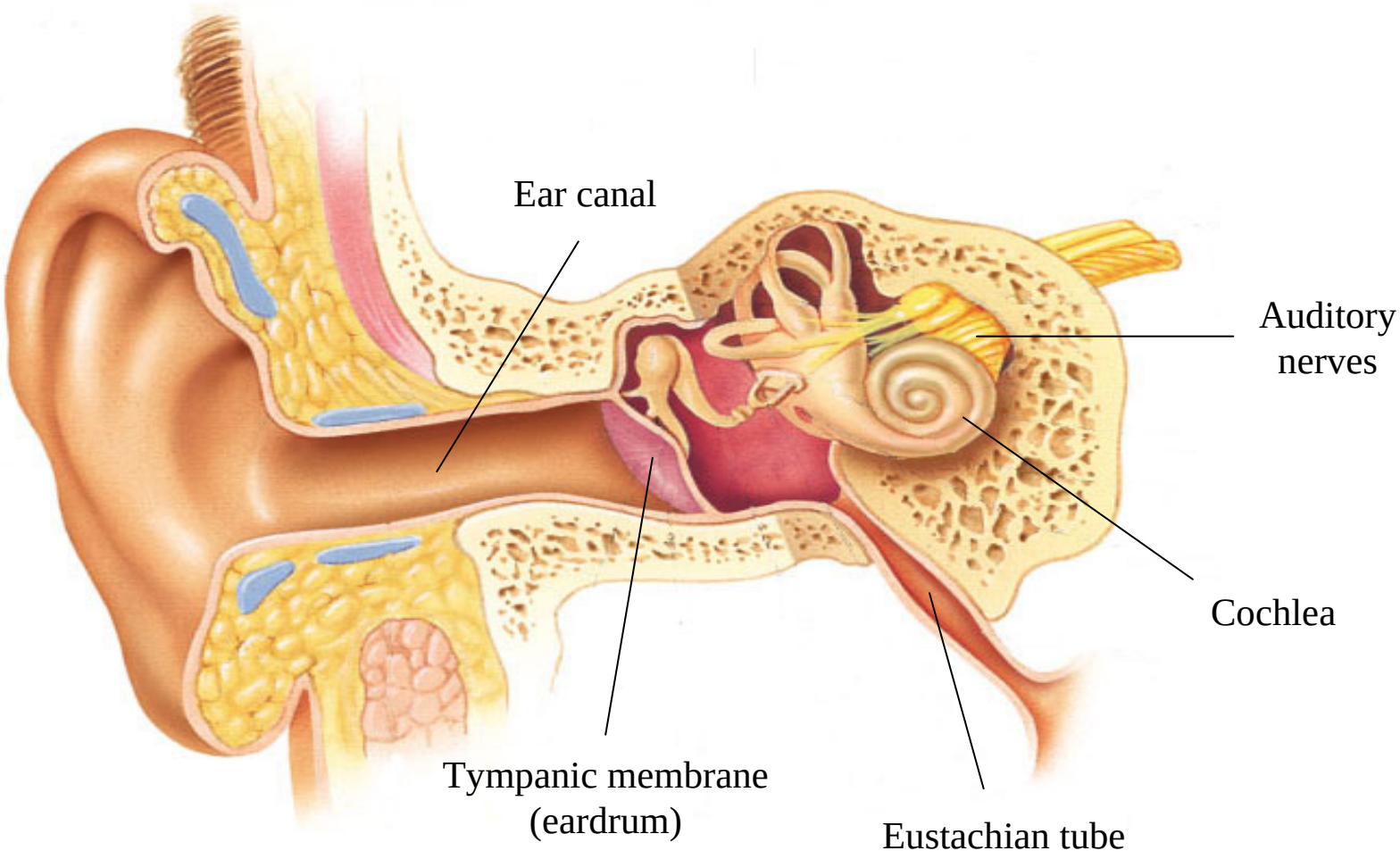


Color perception

Music perception

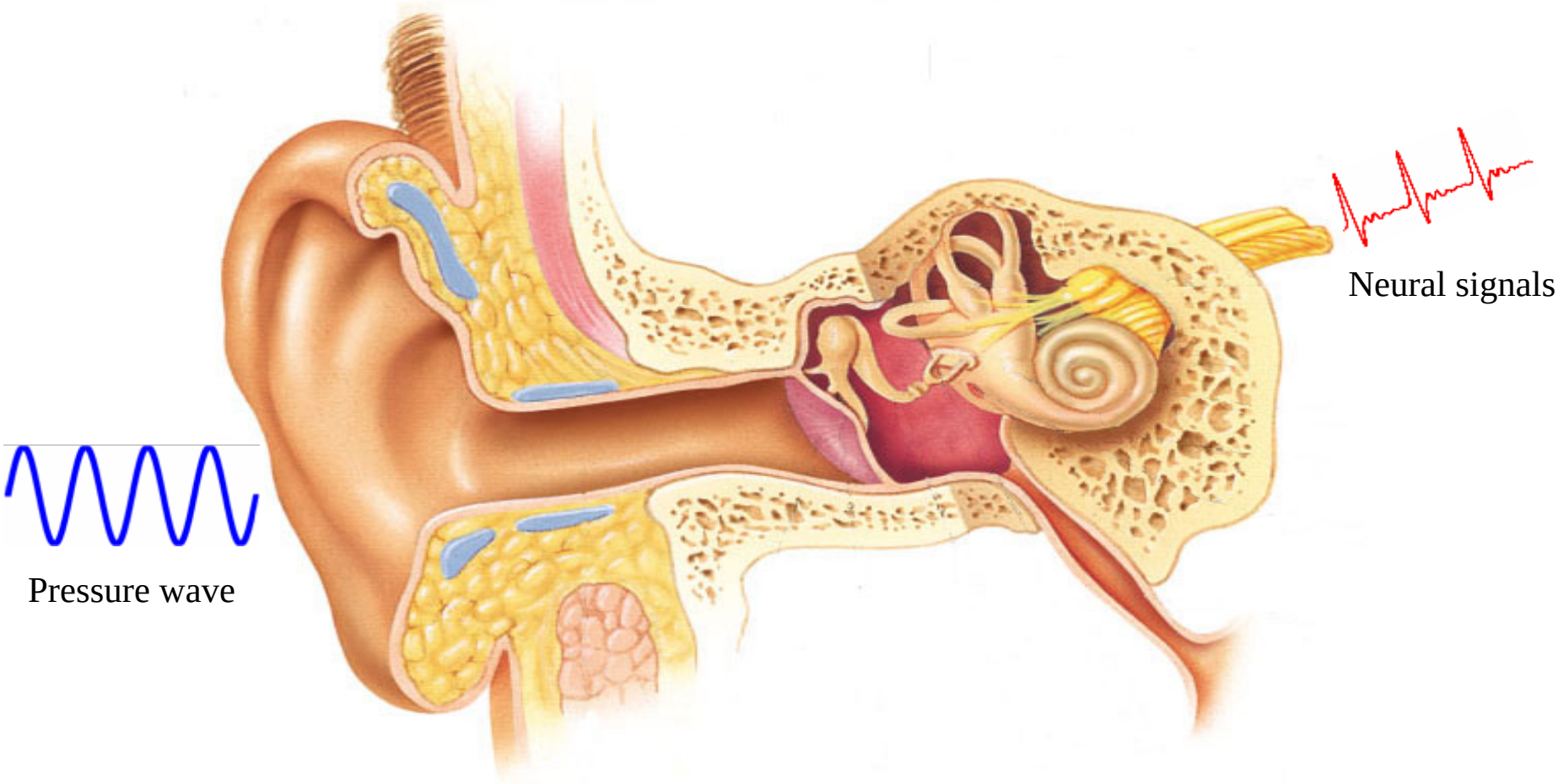
3. Sound Perception

Inner ear structure



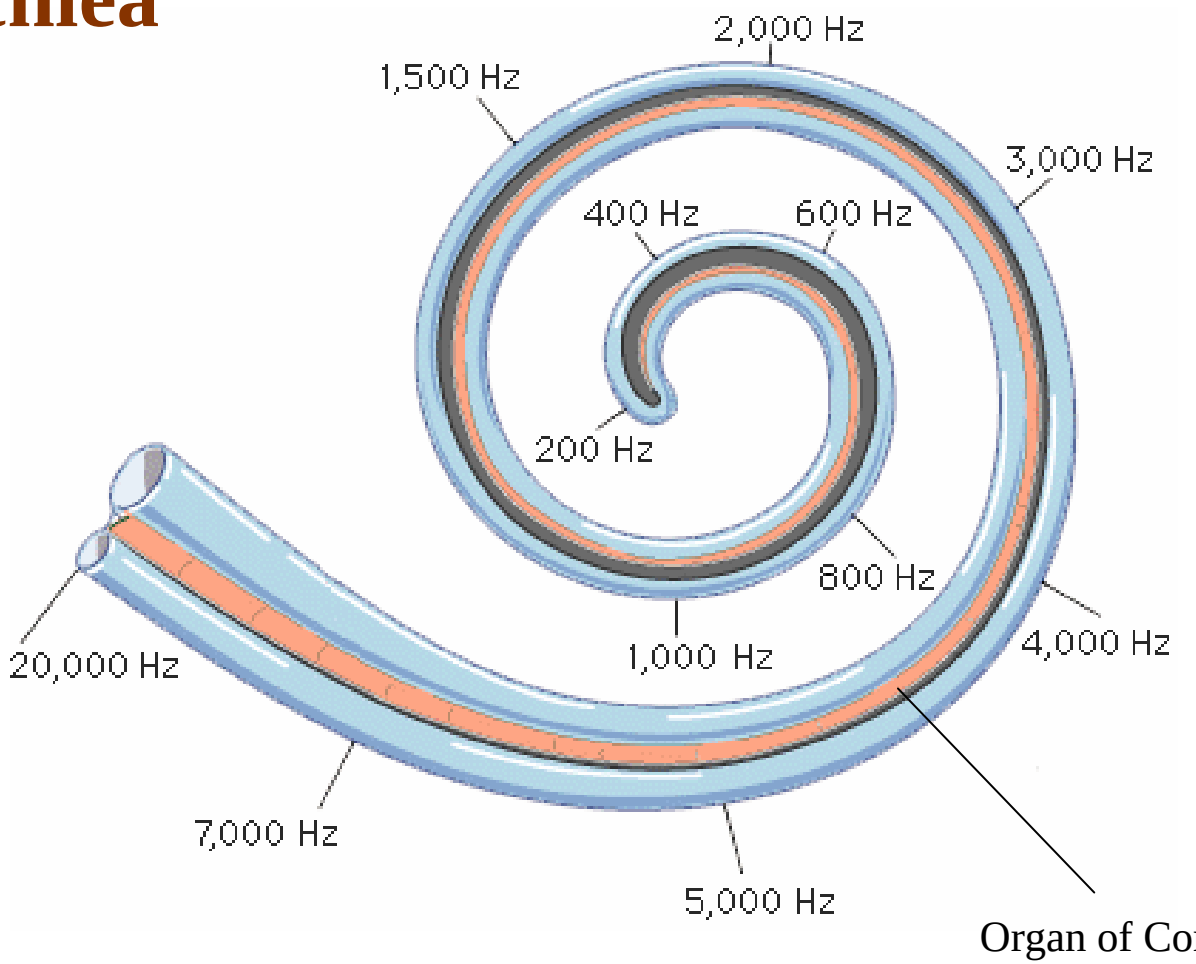
3. Sound Perception

Signal processing in the inner ear



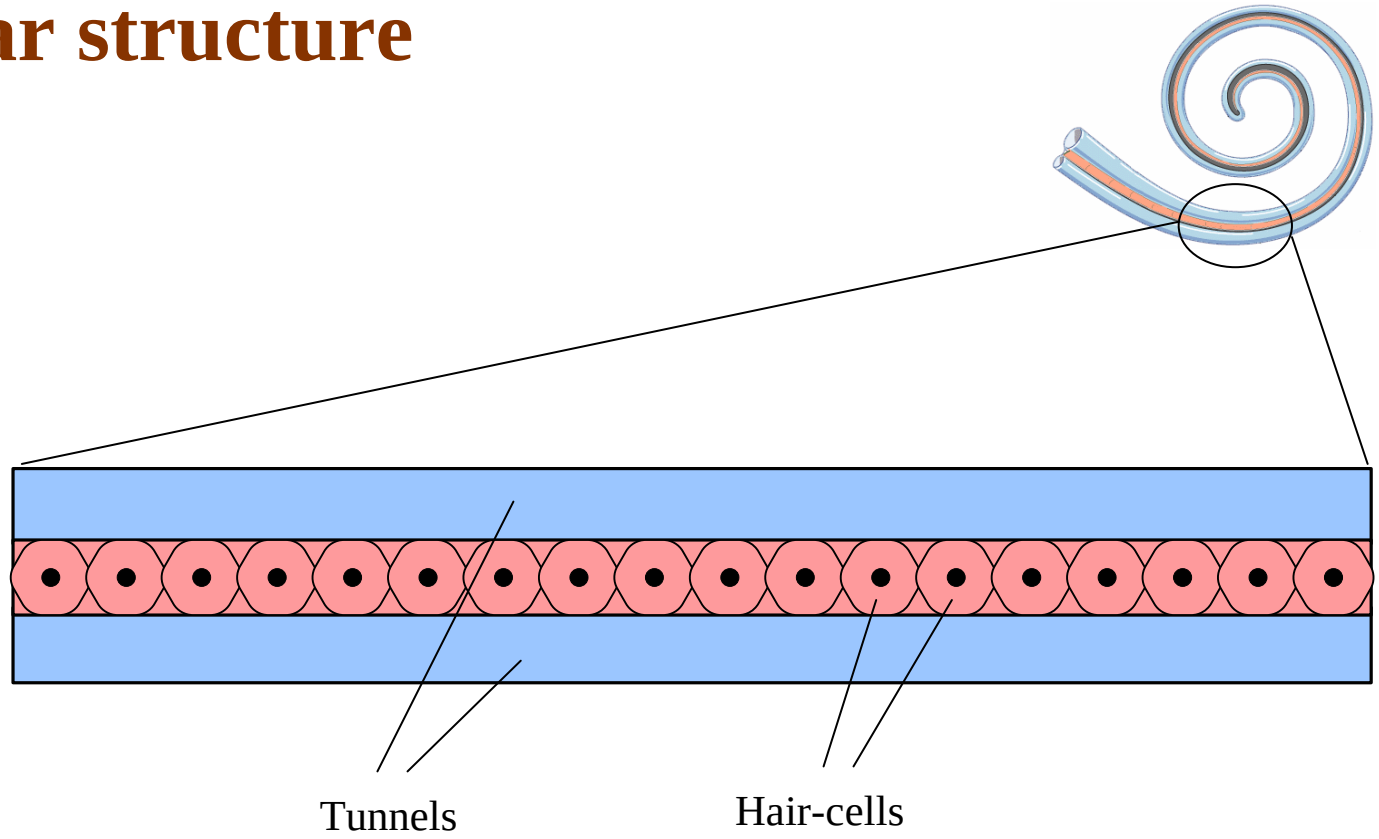
3. Sound Perception

Frequency distribution along the cochlea



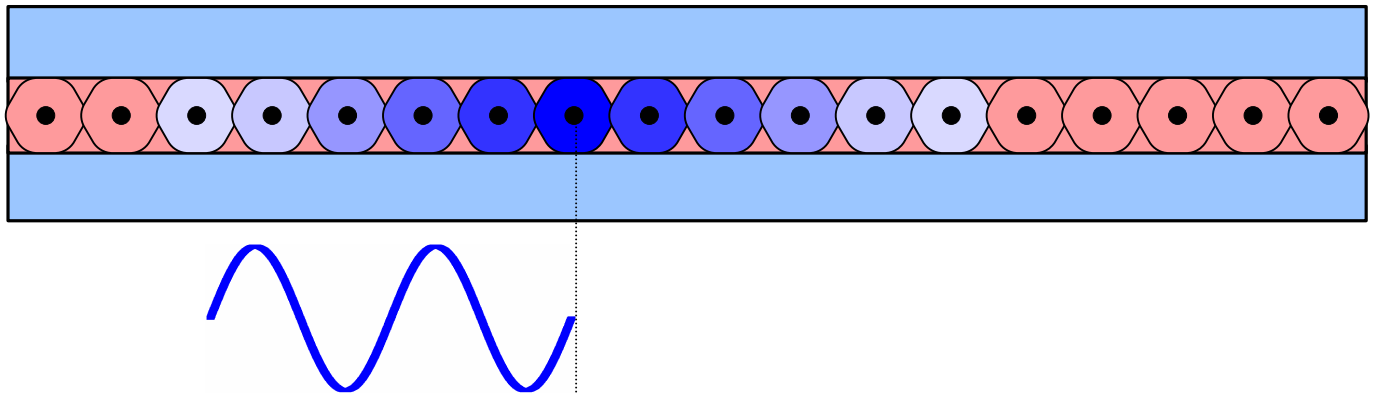
3. Sound Perception

Cochlear structure



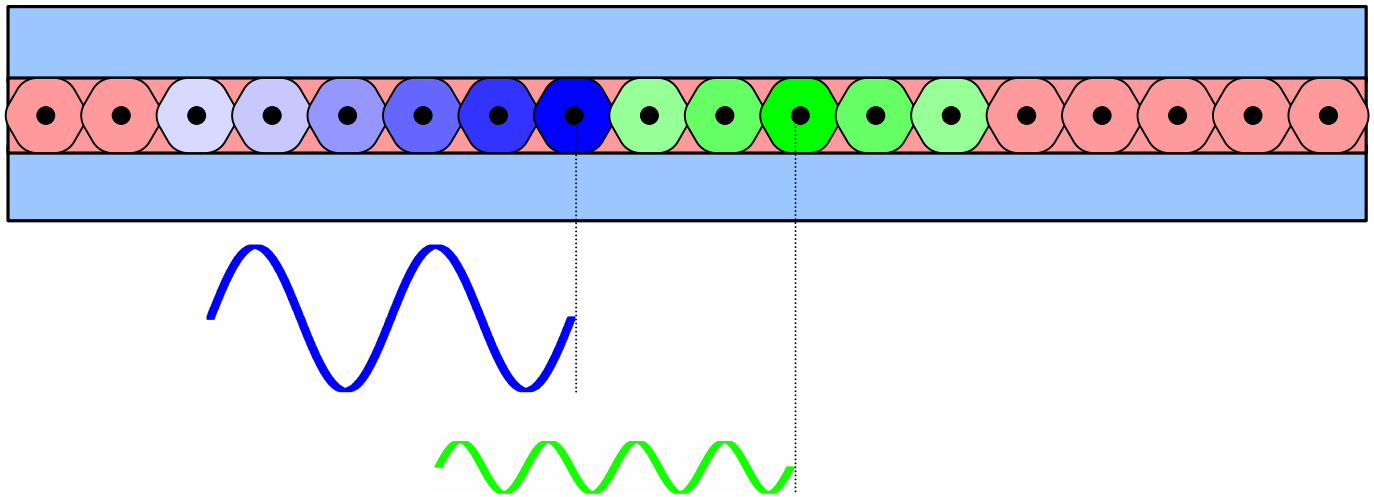
3. Sound Perception

Hair-cell stimulation



3. Sound Perception

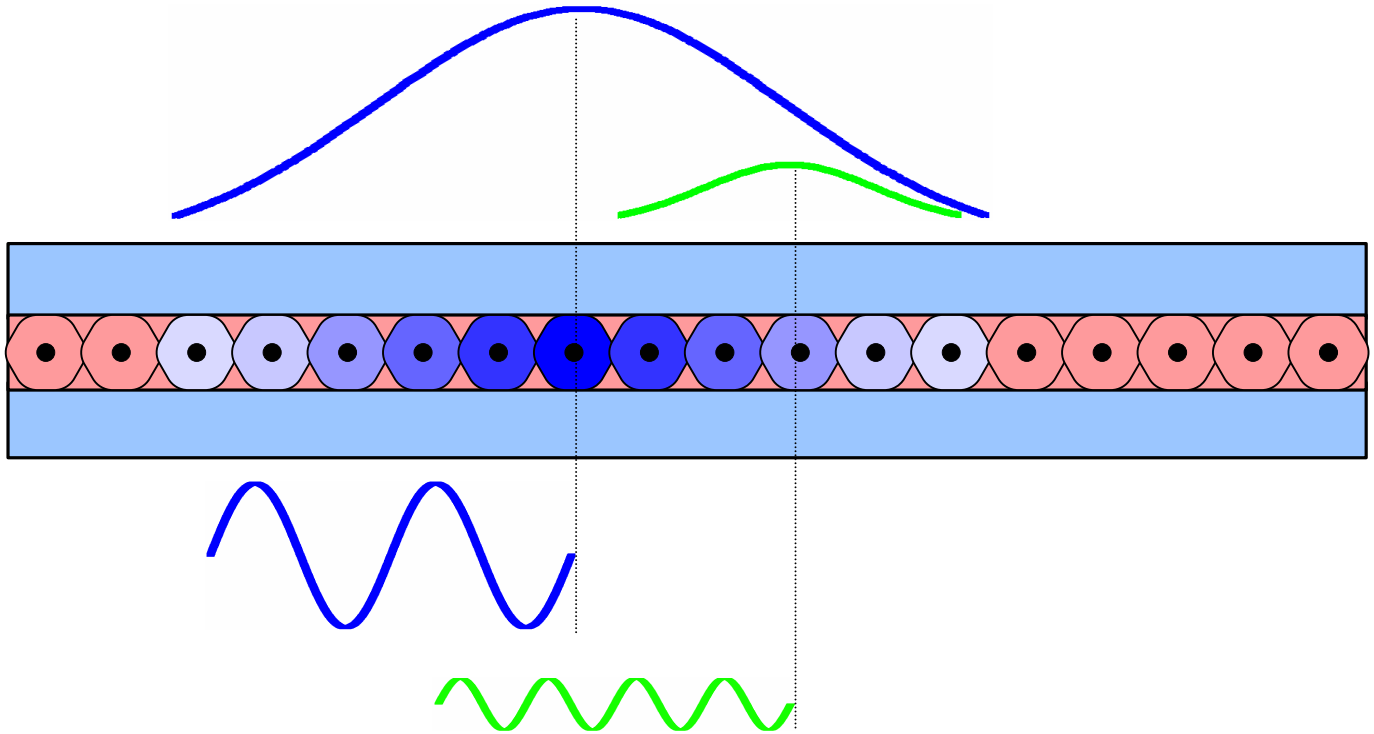
Hair-cell stimulation



3. Sound Perception

Frequency masking

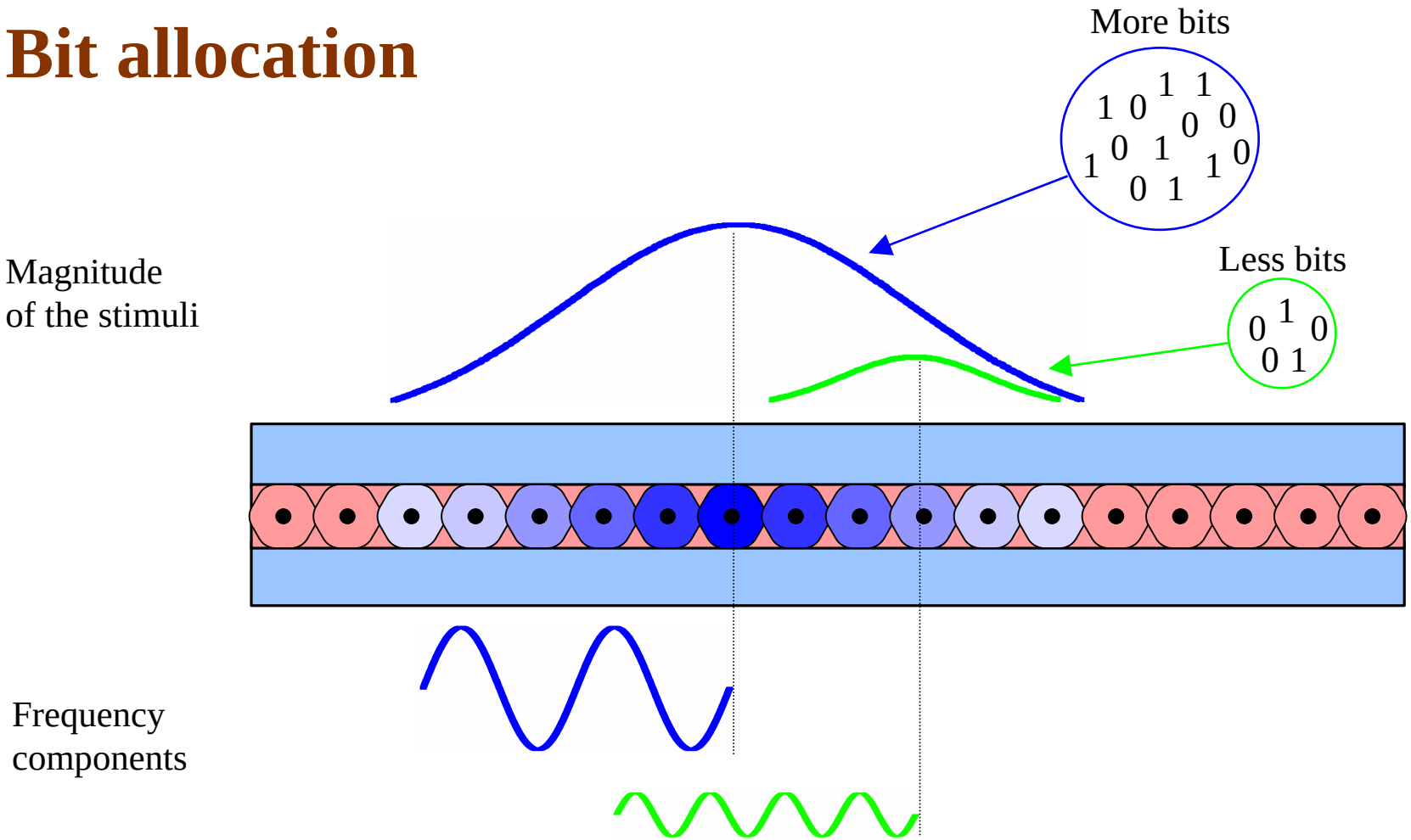
Magnitude
of the stimuli



Frequency
components

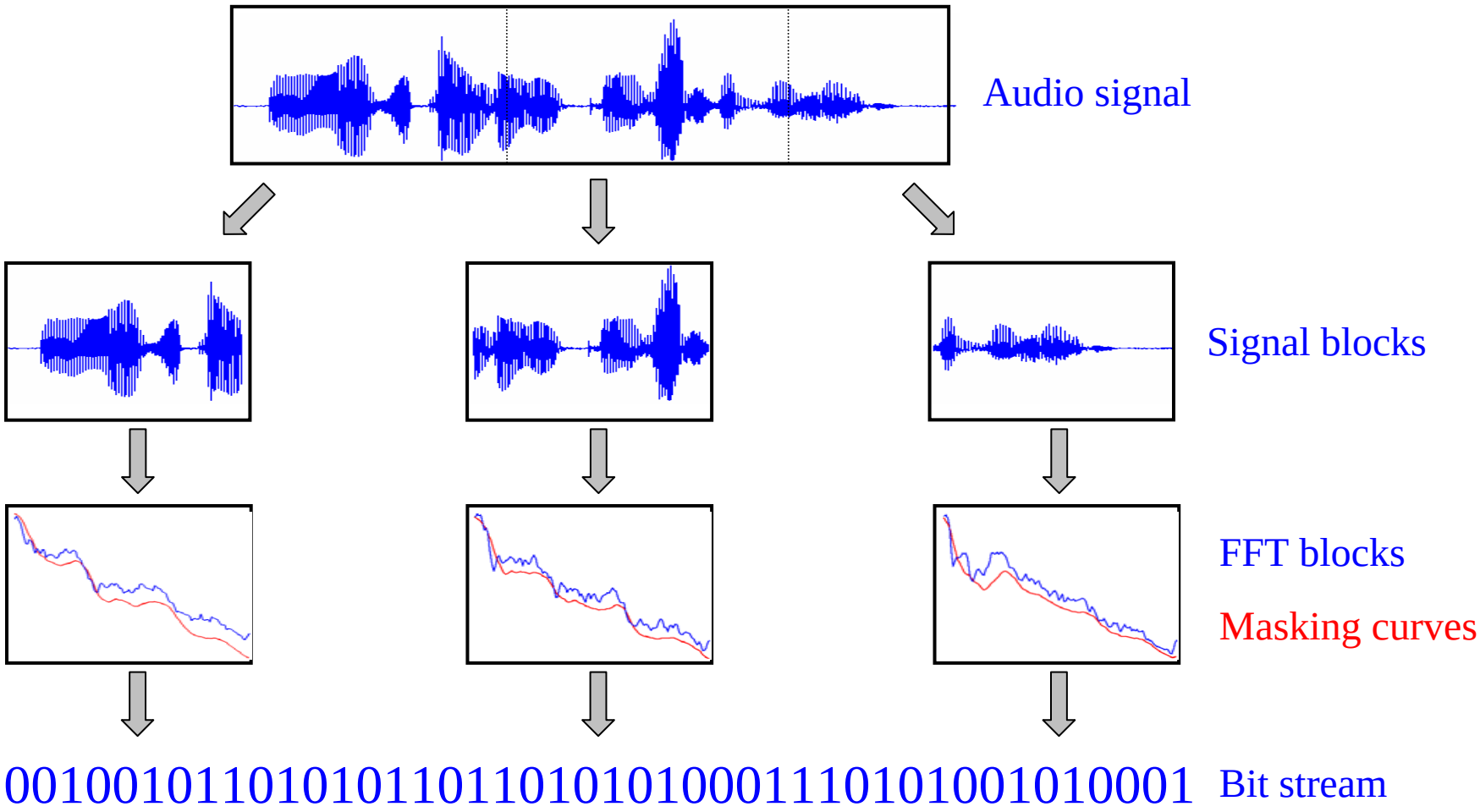
3. Sound Perception

Bit allocation



4. MP3 Standard

Encoding process



4. MP3 Standard

PCM vs MP3

	PCM	MP3
Bit-Rate	1411 Kbit/s	160 Kbit/s
Bits / Sample	32 bit/sample	2.5 bit/sample

5. Impact of MP3

Portability

Vinyl

CD Audio

MP3

5. Impact of MP3

Music sharing

5. Impact of MP3

Legal war against music sharing

«RIAA sues 12-year old girl for alleged copyright infringement made when she was 7.»
CNN, 2004

«83-year-old grandmother, who had died in December of 2004, accused of swapping rock, pop and rap songs.»
The Register, 2005

«I don't understand, how can they sue me if I don't even have a computer?»
James Walls (sued by RIAA), 2006

Lawsuits against end-users

Propaganda by MP3 proponents

6. What if?

«In 1991, the project almost died. During modification tests, the encoding simply did not want to work properly. Two days before submission of the first version of the MP3 codec, we found the compiler error.»

Brandenburg, Fraunhofer Institute

Thank you for your attention!